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Areawide Waste Treatment and Water Quality Management Planning. Orchard Land Conversion and Water Quality

Greater Egypt Regional Planning and Development Commission, Carbondale, IL

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This document is part of the continuing planning process under the Areawide Waste Treatment and Water Quality Management Plan for Southern Illinois. It was prepared under Section 208 of the Water Pollution Control Act. It describes potential water quality problems resulting from soil erosion through the conversion of orchard lands to other uses within the watershed of Cedar Lake.

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Areawide Waste Treatment And Water Quality Management Planning

PB81-183360

Orchard Land Conversion And Water Quality

Franklin, Gallatin, Hamilton, Hardin, Jackson, Jefferson, Perry, Pope, Saline, and Williamson Counties, Illinois

GREATER EGYPT REGIONAL PLANNING & DEVELOPMENT COMMISSION

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Areawide Waste Treatment And Water Quality Management Planning

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Orchard Land Conversion And Water Quality

Franklin, Gallatin, Hamilton, Hardin, Jackson, Jefferson, Perry, Pope, Saline, and Williamson Counties, Illinois

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December, 1980

William Kelley, Chairman
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and Development Commission

Lloyd Williams, Chairman
Southeastern Illinois Regional Planning
and Development Commission

Transmitted herewith is the Orchard Land Conversion and Water Quality report. This document addresses the potential impact and corrective activities relating to the conversion of former orchard lands to other uses.

The report is an integral part of the Fiscal Year 1980 Water Quality Management Planning Program. It is designed to meet the contract requirements of Federal Grant P005461-01 with the United States Environmental Protection Agency.

We trust the submittal of this report, as well as others comprising the 1980 Water Quality Management Planning Program, will serve to document the continuing planning activities for water quality management.

Sincerely,

A. S. Kirkikis

A. S. Kirkikis
Executive Director

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Chapter 1

INTRODUCTION

The Federal Water Pollution Control Act (Public Law 92-500) asserts that each state should administer its own water quality program in compliance with the Act and national program. In response to this state designation, in 1975, the Governor of the State of Illinois designated the ten counties served by the Greater Egypt Regional Planning and Development Commission and the Southeastern Illinois Regional Planning and Development Commission as the Southern Illinois Water Quality Management Area. It was felt that these ten counties, Franklin, Gallatin, Hamilton, Hardin, Jackson, Jefferson, Perry, Pope, Saline and Williamson, which encompass almost the entire Big Muddy and Saline River Basins, had factors affecting water quality which made the area unique in the state and which should be addressed from an areawide perspective.

In early 1979, the Areawide Waste Treatment and Water Quality Management Plan for Southern Illinois was finalized and submitted to the Illinois Environmental Protection Agency and the U. S. Environmental Protection Agency. Since that time numerous counties, municipalities, soil and water conservation districts and river conservancy districts have endorsed and participated in implementing the Plan.

This report documents the activities and findings of a project which explored the potential water quality problems resulting from changing uses of orchard land in the Cedar Lake Watershed. The Greater Egypt Regional Planning and Development Commission also made efforts to develop and prescribe remedies to minimize potential degradation. This is a result of findings of the initial plan and the continuing planning process under Section 208 of the Federal Pollution Control Act as amended.

The Lake

Cedar Lake, approximately 1,800 acres, is a man-made impoundment located six miles south of Carbondale, Illinois in Jackson County. It was a joint effort of the City of Carbondale and the U. S. Forest Service, which own and manage the north and south halves respectively.

The dams to create the lake consist of a main dam and a saddle dam. Dam closure was completed in 1973, and normal pool reached in 1974 (elevation: 431.0 feet, volume: 41,500 acre-feet). The purposes of constructing the lake were to provide a long term water supply for the City of Carbondale and an area for recreational activities.

The Watershed

Cedar Lake Watershed covers 30.2 square miles of southern Jackson County and northern Union County. The general land use breakdown in the watershed is: 50 percent woodland; 13 percent apple and peach orchards; 12 percent row crops and 25 percent permanent pasture, meadow and small grain fields. Poplar Camp, Clay Lick, Mill and the East and West Branches of Cedar Creek are the major tributaries of Cedar Lake.

Little Cedar Lake is also in the watershed. It was formed in 1969 and is entirely owned and managed by the U. S. Forest Service. There is no development planned for that lake. It is intended to remain a natural area.

Another impoundment in the watershed is the Alto Pass Reservoir. It was formed in 1967 as a public water supply for the Village of Alto Pass in Union County.

The Initial Study

During the course of the development of the Areawide Waste Treatment and Water Quality Management Plan for Southern Illinois, concern was expressed regarding mercury content in fish caught in Cedar Lake. In response to this concern, the Greater Egypt Regional Planning and

Development Commission, preparers of the Plan, contracted the Water Quality Section of the Illinois State Water Survey to "delineate the type, distribution and magnitude of pesticides in the aquatic environment of Cedar Lake".[1] The study was funded through the Greater Egypt Regional Planning and Development Commission under Public Law 92-500, Section 208 of the 1972 Water Pollution Control Act.

The resulting report Water Quality Investigations in Cedar Lake, Appendix B-4, Part 1 of the Areawide Waste Treatment and Water Quality Management Plan for Southern Illinois, described its contents as follows:

> "As part of the study, analyses for mineral and pesticide content were performed on the soils of orchards, row crops, pastures and woodland; the water and bottom muds of Cedar Lake, Little Cedar Lake and Alto Pass Reservoir; and the waters, alluvial deposits, and suspended sediments of the four major tributary streams. Surveys to determine the extent of sediment accumulations were performed on the two older lake systems, and relevant fish data regarding pesticide content were evaluated. In addition, the algae and benthic organisms of Cedar Lake were examined and the general limnology of the lake was defined. Arsenic determinations were limited to soil samples."

The Pesticides

Orchard land is not extensive. However, according to transactions of the Illinois State Horticulture Society and the Illinois Fruit Council during the period 1963-1974, fruit growers use 11 to 14 different chemicals per year. These include 14 to 15 applications of insecticides, miticides, fungicides, bactericides, rodenticides and herbicides. In addition, there are chemical applications of fertilizer and chemicals to regulate tree growth and fruit growth. The use of chemicals is extensive.

Many of the chemicals that are used by fruit growers degrade under natural conditions at a relatively rapid rate (a few weeks to less than one year). Others last for periods of longer than a year to virtually non-degradable. Chlorinated hydrocarbons, organophosphates and carbamates are three types of organic pesticides.

Chlorinated hydrocarbons are persistent (longer than one year) and they adhere to soil particles and algae particles within natural waters. They are highly bioaccumulative and concentrations increase in each link of the food chain. The use of these compounds has been prohibited for agriculture nationwide. However, their persistence in the soil makes them a threat even today. "Among these synthetic organic compounds, in order of increasing persistence under anaerobic conditions, are: lindane, heptachlor, endrin, DDT, aldrin, heptachlor, expoxide and dieldrin."[2]

Organophosophates are chemical compounds which are considered non-persistent. With normal application they last several weeks to several months. These compounds include malathion, guthion, parathion and imidan. They are now used in place of the chlorinated hydrocarbons.

Carbamates are also non-persistent. Field studies for these and the organophosphates are lacking in terms of the degradation of by-products. Carbaryl, zineb, dikar and ferman are carbamates.

Inorganic pesticides leave residues containing arsenic, lead, copper, zinc and mercury. These residues are persistent, virtually non-degradable, and toxic.

Table 1 lists pesticides used by Southern Illinois fruit growers according to Transactions of the Illinois State Horticulture Society and the Illinois Fruit Council for 1963-1974.

Lead arsenate and Kelthane were the two pesticides with high bio-accumulativity and low biodegradability. These are the compounds with the highest likelihood for causing water quality damage. Morever, the chlorinated hydrocarbons used in the past are still held in the orchard soils and pose a threat to water quality.

The Problem

At present, these pesticides are not causing excessive damage. Orchards are kept under heavy sod which minimizes soil erosion. Soil movement would carry the pesticides into the water system with soil particles and create a hazard.

Table 1

MAJOR PESTICIDES USED, 1963-1974

	Years Used	Class	Bioaccum-ulativity	Bio-Degrad-ability
Insecticides				
Guthion	11	Organophosphate	None	High
Lead Arsenate	7	Inorganic	High	Low
Malathion	5	Organophosphate	None	High
Parathion	4	Organophosphate	None	High
Imidan	4	Organophosphate	None	High
Miticides				
Kelthane	3	Organochlorine	High	Low
Tedion (Tetradifon)	2			
Morocide (Binapacryl)	3			
Sevin	2	Carbamate	None	High
Fungicides				
Zineb	9	Carbamate	None	High
Cyprex (Dodine)	8			
Captan (Orthocide)	6	Phthalimide		
Dikar	5	Carbamate	None	High
Streptomycin	4			
Karathane (Dinocup)	4			
Niacide	3		None	High
Polyram	3	Carbamate	None	High
Sulfur	3			

Source: Greater Egypt Regional Planning and Development Commission, Areawide Waste Treatment and Water Quality Management Planning, Appendix B-4, Part 1, Water Quality Investigation in Cedar Lake, Publication No. GERPDC 78-489, 1978.

The problem occurs when the orchard soil is disturbed. This can happen when the orchard owner uproots old trees to plant new trees or when the orchard land is converted to other uses such as row crop, pasture, woodland or development. Erosion controls are desirable during periods when orchard land is disturbed in order to prevent these pesticides from entering streams in the Cedar Lake Watershed, and eventually the water supply for the City of Carbondale and the rural water districts supplied by Carbondale.

Although heavy runoff into bodies of water do create problems, this report will address hazards resulting from the toxic substances attached to the eroding soil.

The Purpose

The purpose of this report is to examine ways to minimize movement of pesticides retained in orchard soils to Cedar Lake. Four basic areas will be addressed:

1. Soil erosion control practices currently in use and barriers to additional control measures will be defined;

2. Each land use conversion will be defined in terms of potential water quality damage resulting from the change over and the new use;

3. Land uses will be prioritized according to the relative hazard for erosion created by conversion from orchard lands if no erosion controls are applied; and

4. Soil erosion control measures will be recommended for lands taken out of orchard production.

Chapter 2

SOIL LOSS POTENTIAL DURING ORCHARD LAND CONVERSIONS

Uprooting Old Trees

Orchard owners in the Cedar Lake Watershed are well aware of the erosion problems and potential water quality damage associated with their operation. The conservation practices they use demonstrate their concern and willingness to minimize damage from orchard land. The presently known orchards lie predominately in the Northwest Drainage Area, Clay Lick Creek Subwatershed, Poplar Camp Creek Subwatershed, and Cedar Creek Subwatershed. These are the areas that will be addressed specifically (Figure 1).

The orchard operation that has the greatest potential for erosion is the uprooting of old trees. Apple trees that are well tended become unproductive after approximately 40 years, while peach trees have a shorter period of productivity. After the last crop, which is usually in late July, the old trees are bulldozed. As soon as possible rye or winter wheat is sown (rye in August, winter wheat in September). These are planted as a soil erosion control measure and are considered to be an excellent method for controlling erosion.

To estimate the amount of potential soil loss during this time of old tree removal and cover establishment the Universal Soil Loss Equation (USLE) is used. (For complete explanation, see Appendix.) Briefly, the USLE is expressed

$$A = R K L S C P$$

where:

A = soil loss expressed in tons per acre per year
R = average rainfall
K = soil erodibility
L = slope length
S = slope gradient
C = land use
P = conservation practice

Using factors reported in the Priority Areas: Rend Lake and Cedar Lake document and Soil Conservation Service data, Table 2 was developed. It should be noted that these numbers are not to be considered absolute values, they are only estimates. Also, even though figures for sub-watersheds are available, averages are used. Specific orchard sites may have soil loss figures considerably higher or significantly lower. This should be noted for all numbers in this report that are derived by the USLE.

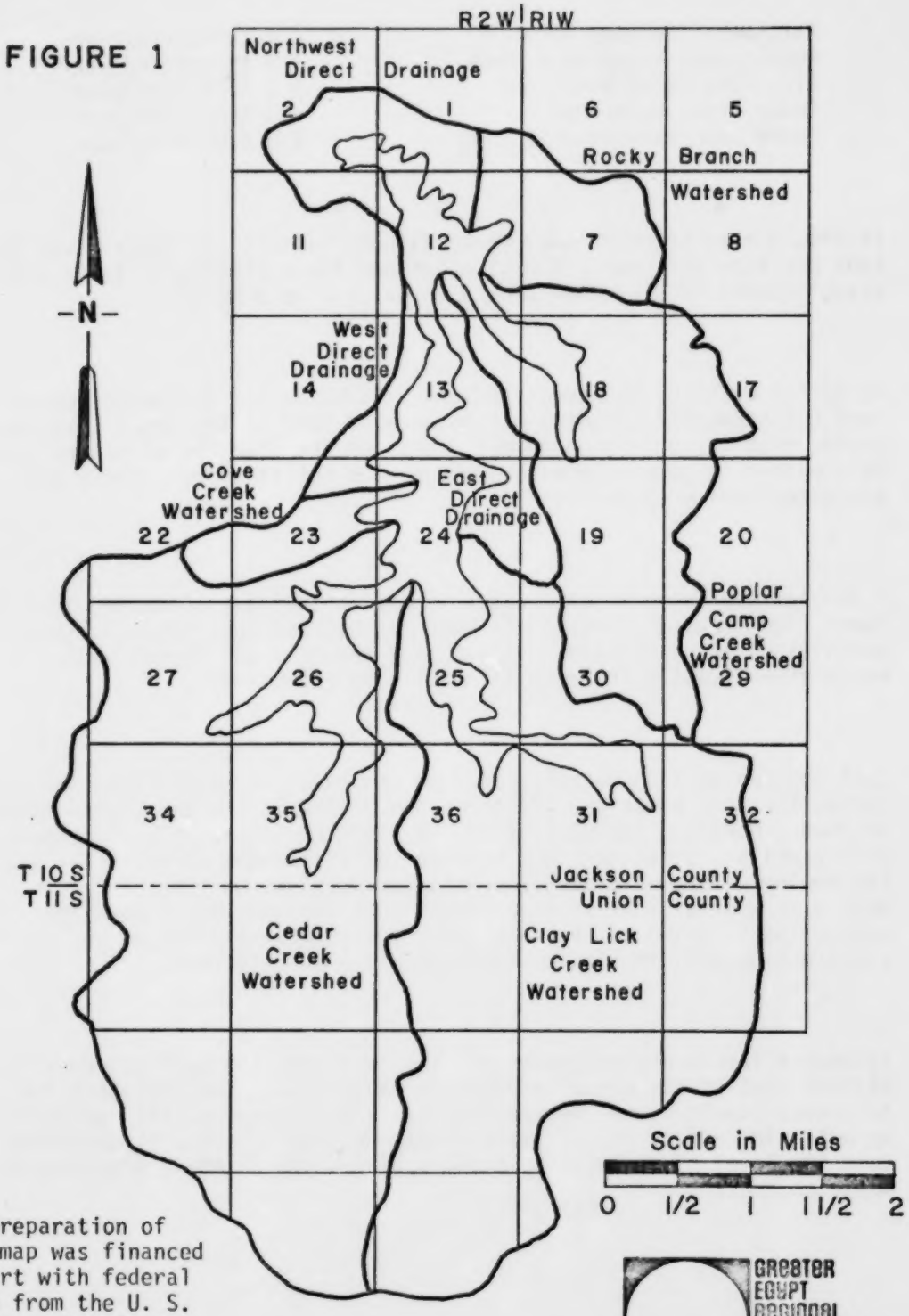
Soil Loss Estimates

Estimating soil loss is difficult for the interim period between old tree removal and establishing a land cover. In Table 2, under "No appreciable canopy" and "zero percent ground cover", it is estimated that 130.23 tons per acre per year of soil loss would occur in the interim between the tree removal and the beginning of an established stand in the Cedar Lake Watershed. During the establishment of the stand, the percent of ground cover would increase. Thus, the tons lost per acre per year would decrease from the 130.23 tons/acre/year to .87 tons/acre/year when the ground cover is firmly established. The ground cover used by the orchard owners during this period is rye or winter wheat. These would have only slightly higher soil loss estimates than the figures used in Table 3 for pasture and grass.

Table 3 also shows the estimated soil loss for this uprooting process in three subwatersheds; Northwest Drainage Area, 149.69 - .99 tons/acre/year; Clay Lick Creek Subwatershed, 136.11 - .90 tons/acre/year; Cedar Creek Subwatershed, 127.33 - .84 tons/acre/year; and Poplar Camp Creek Sub-watershed, 123.55 - .82 tons/acre/year. Again figures may be higher for rye and winter wheat than these figures for grass. In the Priority Areas: Rend Lake and Cedar Lake Watersheds report, the following tolerance levels were determined for each watershed:

CEDAR LAKE WATERSHED

FIGURE 1



The preparation of this map was financed in part with federal funds from the U. S. Environmental Protection Agency under grant number P005461-01

GREATER EGYPT REGIONAL PLANNING & DEVELOPMENT COMMISSION

Northwest Drainage Area	4.4 tons/acre/year
Poplar Camp Creek Watershed	3.9 tons/acre/year
Clay Lick Creek Watershed	4.1 tons/acre/year
Cedar Creek Watershed	4.4 tons/acre/year
Cedar Lake Watershed Average	4.0 tons/acre/year

It should also be noted that these figures reported in Table 3 are in tons per acre per year. The time between the uprooting of trees and the establishment of a partial ground cover is 2 to 3 months.

No matter what the intended land use will be in the following year, the land use conversion process of old orchard land in the Cedar Lake Watershed begins with the uprooting of old trees and the planting of ground cover. This method is generally an economical and satisfactory process and minimizes soil erosion.

A problem may arise if the season is dry following the seeding of ground cover. The stand may be slow in starting without sufficient moisture. The established stand may also be poor, not reaching 90% ground cover. This would significantly increase the soil loss estimates.

Soil erosion control measures used on construction sites could be used during the time after the old trees are bulldozed and the ground cover is sown. However, applying straw, hay, crushed stone or wood chips would be expensive. Since the time between the bulldozing of the trees and the sowing of ground cover is short, its worth as an erosion control method is minimal. If it is expected that the time between bulldozing and sowing is going to be longer than the current 2 weeks or so, these construction soil erosion controls should be considered.

Tolerance levels are estimates of soil loss that the land can survive without loss of its normal production capability. Soil losses below tolerance levels do not necessarily imply that water quality needs will be met. The effect of soil loss levels on water quality is dependent upon the level of pollutants in the soil and the relative proximity of water courses.

Table 2

SOIL LOSS ESTIMATES FOR GROUND COVER[1]

Vegetative Type and Height[2]	Canopy Percent Cover[3]	Type[4]	Percent Ground Cover 0	20	40	60	80	90
			Tons/Acre/Year Soil Loss					
Cedar Lake Watershed								
No Appreciable Canopy	0	G	130.23	57.88	28.94	12.15	3.76	.87
Tall Weeds Or Short Brush With Average Drop Fall Height Of 20 Inches	25	G	104.18	42.20	26.04	10.99	3.47	.87
	50	G	75.24	37.62	20.26	10.13	3.47	.87
	75	G	49.20	28.94	17.36	8.97	3.18	.87
Northwest Drainage Area								
No Appreciable Canopy	0	G	149.69	66.53	33.26	13.97	4.32	.99
Tall Weeds or Short Brush With Average Drop Fall Height Of 20 Inches	25	G	119.75	56.54	29.93	12.64	3.99	.99
	50	G	86.48	43.24	23.28	11.64	3.99	.99
	75	G	56.54	33.26	19.95	10.31	3.65	.99
Clay Lick Creek Subwatershed								
No Appreciable Canopy	0	G	136.11	60.49	30.24	12.70	3.93	.90
Tall Weeds Or Short Brush With Average Drop Fall Height Of 20 Inches	25	G	108.89	51.42	27.22	11.49	3.62	.90
	50	G	78.64	39.32	21.17	10.58	3.62	.90
	75	G	51.42	30.24	18.14	9.37	3.32	.90

Table 2 (cont.)

Vegetative Type and Height[2]	Canopy Percent Cover[3]	Type[4]	Percent Ground Cover 0	20	40	60	80	90
			Tons/Acre/Year Soil Loss					
Cedar Creek Watershed								
No Appreciable Canopy	0	G	127.33	56.59	28.29	11.88	3.67	.84
Tall Weeds or Short Brush With Average Drop Fall Height Of 20 Inches	25	G	101.86	48.10	25.46	10.75	3.39	.84
	50	G	73.56	36.78	19.80	9.90	3.39	.84
	75	G	48.10	28.29	16.97	8.77	3.11	.84
Poplar Camp Creek Watershed								
No Appreciable Canopy	0	G	123.55	54.90	27.45	11.53	3.56	.82
Tall Weeds Or Short Brush With Average Drop Fall Height Of 20 Inches	25	G	98.84	46.67	24.71	10.43	3.56	.82
	50	G	71.38	35.69	19.21	9.60	3.56	.82
	75	G	46.67	27.45	16.47	8.51	3.02	.82

NOTES:
1. The C values used assume that the vegetation and mulch are randomly distributed over the entire area.
2. Canopy height is measured as the average fall height of water drops falling from the canopy to the ground. Canopy effect is inversely proportional to drop fall height and is negligible if fall height exceeds 3 feet.
3. Portion of total area that would be hidden from view by canopy in a vertical projection (a bird's eye view).

Source: Greater Egypt Regional Planning and Development Commission staff; and Soil Conservation Service.

Table 3

SOIL LOSS ESTIMATES FOR
PERMANENT PASTURE AND GRASSLANDS[1]

Vegetative Type and Height[2]	Canopy Percent Cover[3]	Type[4]	Percent Ground Cover 0	20	40	60	80	90
			Tons/Acre/Year Soil Loss					
Cedar Lake Watershed								
No Appreciable Canopy	0	G	130.23	57.88	28.94	12.15	3.76	.87
		W	130.23	69.45	43.41	26.04	12.44	3.18
Tall Weeds Or Short Brush With Average Drop Fall Height Of 20 Inches	25	G	104.18	42.20	26.04	10.99	3.47	.87
		W	104.18	57.88	37.62	23.73	11.86	3.18
	50	G	75.24	37.62	20.26	10.13	3.47	.87
		W	75.24	46.30	91.83	21.70	11.28	3.18
	75	G	49.20	28.94	17.36	8.97	3.18	.87
		W	49.20	34.73	26.04	19.39	10.99	3.18
Appreciable Brush Or Bushes With Average Drop Fall Of 6½ Feet	25	G	115.76	52.09	26.04	11.57	3.76	.87
		W	115.76	63.67	40.51	24.59	12.15	3.18
	50	G	98.39	46.30	24.59	10.99	3.47	.87
		W	98.39	54.98	37.62	23.44	11.86	3.18
	75	G	81.03	40.51	23.15	10.41	3.47	.87
		W	81.03	42.20	34.73	22.28	11.86	3.18
Trees, But No Appreciable Low Brush Average Drop Fall Height Of 13 Feet	25	G	121.54	54.98	28.94	11.86	3.76	.87
		W	121.54	66.56	40.51	25.18	12.15	3.18
	50	G	112.86	52.09	26.04	11.57	3.76	.87
		W	112.86	60.77	40.51	24.59	12.15	3.18
	75	G	104.18	42.20	26.04	11.28	3.47	.87
		W	104.18	57.88	37.62	24.02	11.86	3.18
Northwest Drainage Area								
No Appreciable Canopy		G	149.69	66.53	33.26	13.97	4.32	.99
		W	149.69	79.83	49.89	29.93	14.30	3.65

Table 3 (cont.)

Vegetative Type and Height[2]	Canopy Percent Cover[3]	Type[4]	Percent Ground Cover 0	20	40	60	80	90
			Tons/Acre/Year Soil Loss					
Northwest Drainage Area (cont.)								
Tall Weeds Or Short Brush With Average Drop Fall Height Of 20 Inches	25	G	119.75	56.54	29.93	12.64	3.99	.99
		W	119.75	66.53	43.24	27.27	13.64	3.65
	50	G	86.48	43.24	23.28	11.64	3.99	.99
		W	86.48	53.22	36.59	24.94	12.97	3.65
	75	G	56.54	33.26	19.95	10.31	3.65	.99
		W	56.54	39.88	29.93	22.28	12.64	3.65
Appreciable Brush Or Bushes, With Average Drop Fall Of 6½ Feet	25	G	133.05	59.87	29.93	13.30	4.32	.99
		W	133.05	73.18	46.57	28.27	13.97	3.65
	50	G	113.09	53.22	28.27	12.64	3.99	.99
		W	113.09	63.20	43.24	26.94	13.64	3.65
	75	G	93.13	46.57	26.61	11.97	3.99	.99
		W	93.13	56.54	39.88	25.61	13.64	3.65
Trees. But No Appreciable Low Brush. Average Drop Fall Height Of 13 Feet	25	G	139.70	63.20	33.26	13.63	4.32	.99
		W	139.70	76.50	46.57	28.93	13.97	3.65
	50	G	129.73	59.87	29.93	13.30	4.32	.99
		W	129.73	69.85	46.57	28.27	13.97	3.65
	75	G	119.75	56.54	29.93	12.97	3.99	.99
		W	119.75	56.53	43.24	27.60	13.64	3.65
Clay Lick Creek Watershed								
No Appreciable Canopy	0	G	136.11	60.49	30.24	12.70	3.93	.90
		W	136.11	72.59	45.37	27.22	13.00	3.32
Tall Weeds Or Short Brush With Average Drop Fall Height Of 20 Inches	25	G	108.89	51.42	27.22	11.49	3.62	.90
		W	108.89	60.49	39.32	24.80	12.40	3.32
	50	G	78.64	39.32	21.17	10.58	3.62	.90
		W	78.64	48.39	33.27	22.68	11.79	3.32
	75	G	51.42	30.24	18.14	9.37	3.32	.90
		W	41.42	36.29	27.22	20.26	11.49	3.32

Table 3 (cont.)

Vegetative Type and Height[2]	Canopy Percent Cover[3]	Type[4]	Percent Ground Cover 0	20	40	60	80	90
			Tons/Acre/Year Soil Loss					
Clay Lick Creek Watershed (cont.)								
Appreciable Brush Or Bushes, With Average Drop Fall Of 6½ Feet	25	G	120.99	54.44	27.22	12.09	3.93	.90
		W	120.99	66.54	42.34	25.71	12.70	3.32
	50	G	102.84	48.39	25.71	11.49	3.62	.90
		W	102.84	57.47	39.32	24.50	12.40	3.32
	75	G	84.69	42.34	24.19	10.88	3.62	.90
		W	84.69	51.42	36.29	23.29	12.40	3.32
Trees, But No Appreciable Low Brush. Average Drop Fall Height of 13 Feet	25	G	127.04	57.47	30.24	12.40	3.93	.90
		W	127.04	69.57	42.34	26.31	12.70	3.32
	50	G	117.96	54.44	27.22	12.09	3.93	.90
		W	117.96	63.52	42.34	25.71	12.70	3.32
	75	G	108.89	51.42	27.22	11.79	3.62	.90
		W	108.89	60.49	39.32	25.10	12.40	3.32
Poplar Camp Creek Subwatershed								
No Appreciable Canopy	0	G	123.55	54.90	27.45	11.53	3.56	.82
		W	123.55	65.89	41.18	24.71	11.80	3.02
Tall Weeds Or Short Brush With Average Drop Fall Height Of 20 Inches	25	G	98.84	46.65	24.71	10.43	3.56	.82
		W	98.84	54.90	35.69	22.51	11.25	3.02
	50	G	71.38	35.69	19.21	9.60	3.56	.82
		W	71.38	43.86	30.20	20.59	10.70	3.02
	75	G	46.67	27.45	16.47	8.51	3.02	.82
		W	46.67	32.94	24.71	18.39	10.43	3.02
Appreciable Brush Or Bushes, With Average Drop Fall Of 6½ Feet	25	G	109.82	49.42	24.71	10.98	3.56	.82
		W	109.82	60.40	38.43	23.33	11.53	3.02
	50	G	93.35	43.86	23.33	10.43	3.56	.82
		W	93.35	52.16	35.69	22.23	11.25	3.02
	75	G	76.87	38.43	21.96	9.88	3.56	.82
		W	76.87	46.67	32.94	21.14	11.25	3.02

Table 3 (cont.)

Vegetative Type and Height[2]	Canopy Percent Cover[3]	Type[4]	Percent Ground Cover 0	20	40	60	80	90
			Tons/Acre/Year Soil Loss					
Poplar Camp Creek Subwatershed (cont.)								
Trees, But No Appreciable Low Brush Average Drop Fall Height Of 13 Feet	25	G	115.31	52.16	27.45	11.25	3.56	.82
		W	115.31	63.14	38.43	23.88	11.53	3.02
	50	G	107.07	49.42	24.71	10.98	3.56	.82
		W	107.07	57.65	38.43	23.33	11.53	3.02
	75	G	98.84	46.67	24.71	10.70	3.56	.82
		W	98.84	54.90	35.69	22.78	11.25	3.02
Cedar Creek Subwatershed								
No Appreciable Canopy	0	G	127.33	56.59	28.29	11.88	3.67	.84
		W	127.33	67.91	42.44	25.46	12.16	3.11
Tall Weeds Or Short Brush With Average Drop Fall Height Of 20 Inches	25	G	101.86	48.10	25.46	10.75	3.39	.84
		W	101.86	56.59	36.78	23.20	11.60	3.11
	50	G	73.56	36.78	19.80	9.90	3.39	.84
		W	73.56	45.27	31.12	21.22	11.03	3.11
	75	G	48.10	28.29	16.97	8.77	3.11	.84
		W	48.10	33.95	25.46	18.95	10.75	3.11
Appreciable Brush Or Bushes, With Average Drop Fall Of 6½ Feet	25	G	113.18	50.93	25.46	11.31	3.67	.84
		W	113.18	62.25	29.61	24.05	11.88	3.11
	50	G	96.20	45.27	24.05	10.75	3.39	.84
		W	96.20	53.76	36.78	22.91	11.60	3.11
	75	G	79.22	39.61	22.63	10.18	3.39	.84
		W	79.22	48.10	33.95	21.78	11.60	3.11
Trees, But No Appreciable Low Brush. Average Drop Fall Height Of 13 Feet	25	G	118.84	53.76	28.29	11.60	3.67	.84
		W	118.84	65.08	39.61	24.61	11.88	3.11
	50	G	110.35	50.93	25.46	11.31	3.67	.84
		W	110.35	59.42	39.61	24.05	11.88	3.11
	75	G	101.86	48.10	25.46	11.03	3.39	.84
		W	101.86	56.59	36.78	23.48	11.60	3.11

Source: Greater Egypt Regional Planning and Development Commission staff and Soil Conservation Service.

Notes For Table 3:

1. The C values used assume that the vegetation and mulch are randomly distributed over the entire area.

2. Canopy height is measured as the average fall height of water drops falling from the canopy to the ground. Canopy effect is inversely proportional to drop fall height and is negligible if fall height exceeds 3 feet.

3. Portion of total area that would be hidden from view by canopy is a vertical projection (a bird's eye view).

4. G: Cover at surface is grass, grasslike plants, decaying compacted duff, or litter at least 2 inches deep.

   W: Cover at surface is mostly broadleaf herbaceous plants (as weeds with little lateral-root network near the surface), undecayed residues, or both.

Chapter 3

THE EFFECT OF NEW LAND USES FOR ORCHARD LANDS

There are seven probable land use conversions of old orchard land in Southern Illinois. They are:

1. pasture
2. meadow (hay)
3. row crops
4. new orchard
5. woods (no production)
6. large tract construction
7. small scale construction

This chapter will address these various land uses in relation to:

1. their potential impact on water quality
2. orchard owners operations in the land uses
3. possible further minimization of soil loss

Some of these new land uses may be temporary. In a great many cases with Cedar Lake Watershed orchards, old trees are uprooted, the land placed into another use for three years, and then returned to orchard use. Therefore, the old orchard land may be in pasture, meadow or row crop for three years at the end of which new trees will be planted. Forest and construction conversions from orchard are more permanent and are not expected to revert back to orchard use. It is also possible that orchard land which is put into pasture, meadow or row crop will remain in these uses and not revert to orchard use after three years.

Pasture and Meadow

Although these are two separate land uses in the Cedar Lake Watershed, their soil loss potential is the same.

The rye or winter wheat that was planted after the uprooting of the old trees is sometimes left for the three seasons until new trees are planted. During this time the cover is mowed and allowed to regrow creating a grasslike sod. This practice does a great deal to minimize soil erosion.

With 80%-90% ground cover, the amount of erosion that might be expected would be minimal: .89 - 4.32 tons/acre/year. However, with less than an 80% ground cover, the erosion rates become hazardous, 8.51 - 13.63 tons/acre/year for 60% cover; 16.47 - 33.26 tons/acre/year for 40% cover; 27.45 - 66.53 tons/acre/year for 20% cover; and 76.87 - 149.69 tons/acre/year for zero cover (Table 3). It is not a common practice for the orchard owners to put old orchard lands into permanent pasture or meadow, or leave it in those uses for the three years before planting new orchards. However, in the cases where the land is left in pasture or meadow, an 80%+ ground cover should be maintained to insure minimal soil loss. Poor stands should be resown to the 80%+ land cover level.

Row Crop

A common practice among the orchard owners in the Cedar Lake Watershed is to uproot the old trees, plant in a winter cover and in the spring plant corn or soybeans for three seasons before planting new trees. Soybean is the predominate crop. The orchard owners plant their crops on the contour and some strip crop as well. After harvest, a winter cover of rye, oats or wheat is planted to further minimize soil erosion. Wheat is preferred because it grows in faster.

Tables 4, 5 and 6 show soil loss estimates in the Cedar Lake Watershed, the Northwest Drainage Area, Clay Lick Creek Subwatershed, Cedar Creek Subwatershed and Poplar Camp Creek Watershed using contour plowing, strip cropping or both of these soil erosion control measures.

Table 4

SOIL LOSS ESTIMATES FOR CROPLAND USING STRIPCROPPING

Land Slope Percent	P Values			Soil Loss With P Tons/Acre/Year			Soil Loss Without P Tons/Acre/Year
	A	B	C	A	B	C	
Cedar Lake Watershed							
1 - 2	.30	.45	.60	22.5	33.8	45.1	75.24
3 - 5	.25	.38	.50	18.8	23.5	37.6	75.24
6 - 8	.25	.38	.50	18.8	28.5	37.6	75.24
9 - 12	.30	.45	.60	22.5	33.8	45.1	75.24
13 - 16	.35	.52	.70	26.3	39.1	52.6	75.24
17 - 20	.40	.60	.80	30.0	45.1	60.1	75.24
21 - 25	.45	.68	.90	33.8	51.1	67.7	75.24
Northwest Drainage Area							
1 - 2	.30	.45	.60	25.9	38.9	51.8	86.48
3 - 5	.25	.38	.50	21.6	32.8	43.2	86.48
6 - 8	.25	.38	.50	21.6	32.8	43.2	86.48
9 - 12	.30	.45	.60	25.9	38.9	51.8	86.48
13 - 16	.35	.52	.70	30.2	44.9	60.5	86.48
17 - 20	.40	.60	.80	34.5	51.8	69.1	86.48
21 - 25	.45	.68	.90	38.9	58.8	77.8	86.48
Clay Lick Creek Watershed							
1 - 2	.30	.45	.60	23.5	35.3	47.1	78.64
3 - 5	.25	.38	.50	19.6	29.8	39.3	78.64
6 - 8	.25	.38	.50	19.6	29.8	39.3	78.64
9 - 12	.30	.45	.60	23.5	35.3	47.1	78.64
13 - 16	.35	.52	.70	27.5	40.8	55.0	78.64
17 - 20	.40	.60	.80	31.4	47.1	62.9	78.64
21 - 25	.45	.68	.90	35.3	53.4	70.7	78.64
Cedar Creek Watershed							
1 - 2	.30	.45	.60	22.0	33.1	44.1	73.57
3 - 5	.25	.38	.50	18.3	27.9	36.7	73.57
6 - 8	.25	.38	.50	18.3	27.9	36.7	73.57
9 - 12	.30	.45	.60	22.0	33.1	44.1	73.57
13 - 16	.35	.52	.70	25.7	38.2	51.4	73.57
17 - 20	.40	.60	.80	29.4	44.1	58.8	73.57
21 - 25	.45	.68	.90	33.1	50.0	62.2	73.57

Table 4 (cont.)

Poplar Camp Creek Watershed

Land Slope Percent	P Values			Soil Loss With P Tons/Acre/Year			Soil Loss Without P Tons/Acre/Year
	A	B	C	A	B	C	
1 - 2	.30	.45	.60	21.41	32.12	42.82	71.38
3 - 5	.25	.38	.50	17.84	27.12	35.60	71.38
6 - 8	.25	.38	.50	17.84	27.12	35.69	71.38
9 - 12	.30	.45	.60	21.41	32.12	42.82	71.38
13 - 16	.35	.52	.70	24.98	37.11	49.96	71.38
17 - 20	.40	.60	.80	28.55	42.82	57.18	71.38
21 - 25	.45	.68	.90	32.12	48.53	64.24	71.38

Source: Greater Egypt Regional Planning and Development Commission staff and Soil Conservation Service.

Table 5

SOIL LOSS ESTIMATES FOR CROPLAND USING CONTOURING

Cedar Lake Watershed

Land Slope Percent	P Value	Maximum Length	Soil Loss With P Tons/Acre/Year	Soil Loss Without P Tons/Acre/Year
1 - 2	.60	400'	45.14	75.24
3 - 5	.50	300'	37.62	75.24
6 - 8	.50	200'	37.62	75.24
9 - 12	.60	120'	45.14	75.24
13 - 16	.70	80'	52.66	75.24
17 - 20	.80	60'	60.19	75.24
21 - 25	.90	50'	67.71	75.24
		Northwest Drainage Area		
1 - 2	.60	400'	51.88	86.48
3 - 5	.50	300'	43.24	86.48
6 - 8	.50	200'	43.24	86.48
9 - 12	.60	120'	51.88	86.48
13 - 16	.70	80'	60.58	86.48
17 - 20	.80	60	69.18	86.48
21 - 25	.90	50'	77.83	86.48
		Clay Lick Creek Watershed		
1 - 2	.60	400'	47.18	78.64
3 - 5	.50	300'	39.32	78.64
5 - 8	.50	200'	39.32	78.64
9 - 12	.60	120'	47.18	78.64
13 - 16	.70	80'	55.04	78.64
17 - 20	.80	60'	62.91	78.64
21 - 25	.90	50'	70.77	78.64
		Cedar Creek Watershed		
1 - 2	.60	400'	44.14	73.57
3 - 5	.50	300'	36.78	73.57
6 - 8	.50	200'	36.78	78.57
9 - 12	.60	120'	44.14	73.57
13 - 16	.70	80'	51.49	73.57
17 - 20	.80	60'	58.85	73.57
21 - 25	.90	50'	66.21	73.57

Table 5 (cont.)

Poplar Camp Creek Watershed

Land Slope Percent	P Value	Maximum Length	Soil Loss With P Tons/Acre/Year	Soil Loss Without P Tons/Acre/Year
1 - 2	.60	400'	42.82	71.38
3 - 5	.50	300'	35.69	71.38
6 - 8	.50	200'	35.69	71.38
9 - 12	.60	120'	42.82	71.38
13 - 16	.70	80'	49.96	71.38
17 - 20	.80	60'	57.18	71.38
21 - 25	.90	50'	64.24	71.38

Source: Greater Egypt Regional Planning and Development Commission staff and Soil Conservation Service.

Table 6

SOIL LOSS ESTIMATES FOR CROPLAND
USING CONTOURING AND STRIPCROPPING

Cedar Lake Watershed

Land Slope Percent	Contour P Value	Stripcrop P Value	Soil Loss Using Both Tons/Acre/Year	Soil Loss Without P Tons/Acre/Year
1 - 2	.60	.30	13.5	75.24
3 - 8	.50	.25	9.4	75.24
9 - 12	.60	.30	13.5	75.24
13 - 16	.70	.35	18.4	75.24
17 - 20	.80	.40	24.0	75.24
21 - 25	.90	.45	30.4	75.24
		Northwest Drainage Area		
1 - 2	.60	.30	15.5	86.48
3 - 8	.50	.25	10.8	86.48
9 - 12	.60	.30	15.5	86.48
13 - 16	.70	.35	21.18	86.48
17 - 20	.80	.40	27.6	86.48
21 - 25	.90	.45	35.0	86.48
		Clay Lick Creek Watershed		
1 - 2	.60	.30	14.1	78.64
3 - 8	.50	.25	9.8	78.64
9 - 12	.60	.30	14.1	78.64
13 - 16	.70	.35	19.2	78.64
17 - 20	.80	.40	25.1	78.64
21 - 25	.90	.45	31.8	78.64
		Cedar Creek Watershed		
1 - 2	.60	.30	13.2	73.57
3 - 8	.50	.25	9.1	73.57
9 - 12	.60	.30	13.2	73.57
13 - 16	.70	.35	18.0	73.57
17 - 20	.80	.40	23.5	73.57
21 - 25	.90	.45	29.7	73.57

Table 6 (cont.)

Poplar Camp Creek Watershed

Land Slope Percent	Contour P Value	Stripcrop P Value	Soil Loss Using Both Tons/Acre/Year	Soil Loss Without P Tons/Acre/Year
1 - 2	.60	.30	12.84	71.38
3 - 8	.50	.25	8.92	71.38
9 - 12	.60	.30	12.84	71.38
13 - 16	.70	.35	17.48	71.38
17 - 20	.80	.40	22.84	71.38
21 - 25	.90	.45	28.90	71.38

Source: Greater Egypt Regional Planning and Development Commission staff and Soil Conservation Service.

As indicated by these tables, the soil loss estimates are significant. Even under both strip cropping and contour plowing, average soil loss ranges from 9 to 30 tons per acre per year. With contour plowing only, soil loss estimates range from 36 to 77 tons per acre per year.

Winter cover minimizes the potential soil loss. In some areas where the land is both strip cropped and contour plowed, the additional measure may reduce the estimated soil loss to acceptable levels. Generally, the addition of winter cover does not reduce the estimated soil loss to acceptable levels in most areas which are cropped.

Holding ponds could be used in conjunction with other soil erosion control measures to reduce the amount of toxic substances entering the lake. These ponds do not reduce soil movement but do contain the runoff. The toxic substances adhere to the soil particles. They would wash into a holding pond and eventually settle to the bottom.

Although the orchard owners are conscientious about soil erosion and are taking proper soil erosion control measures, the physical factors present in the Cedar Lake Watershed make row cropping hazardous. With the toxicity present in old orchard soil, potential soil loss of 9 to 77 tons per acre per year for a three year period is potentially hazardous to Cedar Lake. Even sub-tolerance levels of soil loss could be hazardous due to transport of toxic substances when water courses are at close proximity.

Orchard

Currently, the orchard owners put their old orchard land back into orchard use after three years of pasture, meadow or row crop. The amount of potential soil loss from orchard land is usually at or below tolerance levels.

Table 7

SOIL LOSS ESTIMATES FOR ORCHARD LAND (TONS/ACRE/YEAR)

	Soil Loss Estimate	Tolerance Level
Northwest Drainage Area	4.32	4.4
Clay Lick Creek Watershed	3.93	4.1
Cedar Creek Watershed	3.67	4.4
Poplar Camp Creek Watershed	3.57	4.4
Cedar Lake Watershed	3.76	4.0

Source: Greater Egypt Regional Planning and Development Commission, Areawide Waste Treatment and Water Quality Management Plan for Southern Illinois, Priority Areas: Rend Lake and Cedar Lake Watersheds, Publication No. GERPDC 80-554, 1980.

All orchards are in a sod cover which minimizes the amount of potential soil loss. These orchards present a minimal hazard in the Cedar Lake watershed, in terms of tolerance for soil productivity loss (Table 7). However, the presence of toxic substances in the soil may still pose a water quality hazard.

Forest

Changing old orchard to wooded acreage is not currently a common practice in the Cedar Lake Watershed. It is the change with the least potential for soil loss. It is likely to be a permanent change rather than an alternate use before orchard trees are replanted.

Wooded acreage used in this calculation is assumed to have an average of 90% undisturbed forest having 75-100% canopy, and an average of 2 inches floor litter. It assumes an average 10% disturbed or pastured wooded acreage having little litter coverage. This is based on the large amount of relatively undisturbed lands under the management of the U.S. Forest Service and the City of Carbondale.

Table 8 shows the ranges of potential soil loss from wooded acreage in the Cedar Lake Watershed, the Northwest Drainage Area, Clay Lick Creek Watershed, Cedar Creek Watershed and the Poplar Camp Creek Watershed. It is evident from these figures that potential soil loss is extremely minimal ranging from .028 to 2.99 tons per acre per year.

Because of the low potential for soil erosion, old orchard land being converted to wooded land is the best alternative. However, the wooded acreage is not generally an economically feasible alternative for the orchard owner.

Construction

Large tract construction and small scale construction are two permanent land use conversions for old orchard land. Currently, these two uses are not prevalent for old orchard acreage in the Cedar Lake Watershed.

The soil erosion potential from land under construction is severe. Table 9 shows soil loss estimates of land in construction with no soil erosion control measures, straw cover, crushed stone and woodchips for the Cedar Lake Watershed, the Northwest Drainage Area, the Clay Lick Creek Subwatershed, Cedar Creek Subwatershed and the Poplar Camp Creek Subwatershed.

As Table 9 implies, only crushed stone applied at 240 tons per acres and woodchips applied at 25 tons per acre may be effective in minimizing erosion with soil loss estimates ranging from 5.18 to 6.65 tons/acre/year. Even these figures are above tolerance levels. Construction sites not utilizing soil erosion control practices have a potential soil loss of 274.56 to 332.64 tons per acre per year.

Small scale construction (i.e., single family dwelling, 1 or 2 town lots) does create a potential hazard. However, it is the large scale construction projects (shopping mall, residential subdivision) that present the most danger to water quality through soil erosion. The danger lies with large tracts of land being left barren during the construction process.

Table 8

SOIL LOSS ESTIMATES FOR UNDISTURBED FOREST LAND

Cedar Lake Watershed

	Percent Of Area Covered By Duff At Least 2 Inches Deep	Soil Loss Tons/Acre/Year
Percent Of Area Covered By Canopy Of Trees And Undergrowth	100-90	.028 - .289
	85-75	.578 - 1.15
	70-40	.868 - 2.60

Northwest Drainage Area

Percent Of Area Covered By Canopy Of Trees And Undergrowth	100-90	.033 - .332
	85-75	.665 - 1.33
	70-40	.997 - 2.99

Clay Lick Creek Watershed

Percent Of Area Covered By Canopy Of Trees And Undergrowth	100-90	.030 - .302
	85-75	.604 - 1.20
	70-40	.907 - 2.72

Cedar Creek Watershed

Percent Of Area Covered By Canopy Of Trees And Undergrowth	100-90	.028 - .282
	85-75	.565 - 1.13
	70-40	.848 - 2.54

Poplar Camp Creek Watershed

Percent Of Area Covered By Canopy Of Trees And Undergrowth	100-90	.027 - .274
	85-75	.549 - 1.09
	70-40	.823 - 2.47

Source: Greater Egypt Regional Planning and Development Commission staff and Soil Conservation Service.

Table 9

SOIL LOSS ESTIMATES FOR CONSTRUCTION SITES

	Cedar Lake	Northwest Drainage	Clay Lick Creek	Cedar Creek	Poplar Camp Creek
No BMP's	289.40	332.64	302.48	282.96	274.56
Straw, Hay					
1 T/A	57.88	66.53	60.49	56.59	54.91
1.5 T/A	34.72	39.92	36.29	33.95	39.94
2 T/A	31.83	36.59	33.27	31.12	30.20
Crushed Stone					
135 T/A	14.47	16.63	15.10	14.14	13.72
240 T/A	5.18	6.65	6.05	5.66	5.49
Wood Chips					
7 T/A	25.15	26.61	24.20	24.63	21.96
12 T/A	14.47	16.63	15.10	14.14	13.72
25 T/A	5.18	6.65	6.05	5.66	5.49

Source: Greater Egypt Regional Planning and Development Commission staff and Soil Conservation Service.

In the case of residential subdivisions, the old orchard would be bulldozed and individual lots sold through the owner or developer. Houses that were constructed immediately would present a lesser danger. Some lots may remain unsold for a construction season or longer. This would create a severe problem since sites not under construction may be completely neglected.

Large construction projects such as shopping centers or factories present a soil erosion hazard because of the amount of time for such a project to be completed. For example, land for parking lots or access roads may be left barren while the main structure is under construction.

Soil erosion controls may be used to restrict soil loss during the construction process. The amount of crushed rock or wood chips necessary would be considerable and represent a heavy economic burden. Large construction projects may plant grass to restrict soil movement. However, the stand would have to provide an 80-90% ground cover to bring soil loss below tolerance level.

Establishing holding ponds is a method that could restrict the washing of toxic substances into Cedar Lake. It would not reduce soil loss since the soil would wash into the holding pond. However, since the toxic substances are attached to the soil particles, they would eventually settle to the bottom.

Chapter 4

LAND USE PRIORITIZATION

The previous chapter reviewed various land uses in terms of frequency of use and potential soil loss. Soil loss estimate figures derived from the Universal Soil Loss Equation are the only current gauge available to determine the threat to water quality through soil erosion. Table 10 shows average rain, soil erodibility, slope, slope length and land use factors used to derive the soil loss estimates. These figures do not include the use of any soil erosion control measures. Table 11 suggests that priorities for land use conversion should be as follows:

1. woods
2. pasture
3. meadow (hay)
4. orchard
5. row crops
6. small scale construction
7. large tract construction

The poorest choices would change under two circumstances.

1. Assuming no soil erosion control practices were being utilized in either land use, if the land was to remain in row crop for longer than three years and the site was under construction for one year, the potential for water quality damage would be greater for row crop than for construction.

2. If extensive soil erosion control measures were used on the construction site, and little or no control practices used on the row crop land, the row crop would create a greater potential for damage to Cedar Lake.

Table 10

UNIVERSAL SOIL LOSS EQUATION FACTORS
APPLIED TO SOIL LOSS ESTIMATES FOR EACH WATERSHED AREA

USLE Factors	Northwest Drainage	Clay Lick Creek	Cedar Creek Watershed	Poplar Camp Creek	Cedar Lake Watershed
RK	79.2000	79.6000	78.6000	85.8000	80.3900
LS	4.2000	3.8000	3.6000	3.2000	3.6000
P	1.0000	1.0000	1.0000	1.0000	1.0000
C - Co	.0130	.0130	.0130	.0130	.0130
C - Cw	.0027	.0027	.0027	.0027	.0027
C - Ch	.0030	.0030	.0030	.0030	.0030
C - Cp	.0030	.0030	.0030	.0030	.0030
C - Cr	.2600	.2600	.2600	.2600	.2600
C - Cc	1.0000	1.0000	1.0000	1.0000	1.0000

Key to C factors:

Co = orchard use
Cw = woodland
Ch = meadow (hay)
Cp = pasture
Cr = row crop
Cc = construction

Source: Greater Egypt Regional Planning and Development Commission staff and Soil Conservation Service.

Table 11

SOIL LOSS ESTIMATES FOR LAND USES BY WATERSHED
Tons Per Acre Per Year

Type Of Land Use	Northwest Drainage	Clay Lick Creek	Cedar Creek Watershed	Poplar Camp Creek	Cedar Lake Watershed
Orchard Land	4.32	3.93	3.67	3.57	3.76
Woodland	.89	.81	.76	.74	.78
Meadow Land	.99	.91	.85	.82	.87
Pasture	.99	.91	.85	.82	.87
Cropland	86.48	78.64	73.57	71.38	75.24
Construction Site	332.64	302.48	282.96	274.56	289.40

Source: Greater Egypt Regional Planning and Development Commission staff and Soil Conservation Service.

The first four land use conversion priorities have soil loss estimates below tolerance levels and would not create a serious water quality hazard. It should be noted, however, that all of these land uses result from the process which began with the bulldozing of old trees. That process has potential soil loss in and of itself, and should be considered when potential water quality damage is being estimated.

Chapter 5

CONCLUSIONS AND RECOMMENDATIONS

The process of converting old orchard land to another use is on-going in the Cedar Lake Watershed. It is part of the orchard operation to take acreage out of production for three years before planting new trees. Currently, this is the most common occurrence of changing land use. Old orchard land may also be permanently taken out of orchard production and put into one of six other land uses.

Orchard land kept in heavy sod cover contributes a minimal amount of toxic substances to Cedar Lake through soil erosion. The process of changing land use through row cropping or construction causes a potential hazard to Cedar Lake. It must be noted from Chapter 1, that the substances held in the old orchard land are virtually nonbiodegradable and highly bioaccumulative. The lead, arsenic, mercury and copper that are in the old orchard soil will not lose their toxicity substantially. Soil residues may remain at levels potentially hazardous to water quality for many decades. Without special attention to soil erosion control measures, it is likely that these substances will migrate at varying rates to Cedar Lake along with soil particles. It should also be noted that although the current orchard owners are conscientious about minimizing soil erosion, the old orchard lands may not always be under their care.

To insure a minimal amount of soil erosion the following recommendations are offered.

1. All orchard owners who are not currently cooperators with the county soil and water conservation district should become members.

2. Orchard lands should be addressed specifically in the soil and water conservation district guidelines. Maximum soil erosion rates should be set for old orchard land at a rate lower than non-orchard land. Unless soil erosion control measures, beyond those that are presently used, are implemented, old orchard acreage should not be row cropped or used as a consturction site.

3. A soil conservation plan should be made for orchard land by the soil conservation service and conscientiously followed to insure minimal soil erosion.

4. Old orchard lands should be mapped for the Cedar Lake Watershed regardless of their current use. This information should be kept by the soil and water conservation district for use in long term soil erosion control planning.

5. Old orchards in the village limits of Makanda should be specifically addressed in their comprehensive plan. The plan is not binding, but undesirable land use conversions could be avoided if they are addressed in the comprehensive plan.

6. Jackson County should address old orchard land use in any county land use plan. Land uses with a high soil erosion potential should be prohibited in such a plan.

7. Subdivision regulations in any appropriate jurisdiction, city or county, should require the approval of the soil water conservation district on soil erosion control measures that would eliminate potential soil loss from such construction.

These measures are necessary to insure minimal soil erosion from old orchard land. It is necessary to provide long term planning for these acreages because of the nonbiodegradability of the toxic substances held in those soils. Toxic substances in former orchard land will remain attached to the soil particles until it is washed into Cedar Lake. Once in the lake ecosystem it may enter the food chain and be ingested by fish, then wildlife or people. Plans must be made now that will insure minimal soil loss for decades into the future.

There is one major barrier to implementing these recommendations. Any additional soil erosion control practices would create an economic burden on the present land owners. Not putting the old orchard land in row crops during the three years before planting new trees may also be a heavy economic consideration.

There is no substantial social barrier to implementing most soil erosion control measures. All the current orchard owners are cooperative concerning the potential danger to Cedar Lake. However, prohibiting old orchard land from being used in row crop or construction may be distasteful because of the possible economic consequences.

Costs of installing or carrying out certain soil conservation measures can be partly supplied by federal cost sharing through agricultural stabilization and conservation service programs. State sediment and erosion control programs may also become available to help with some specific conservation practices. Designation of the Cedar Lake Watershed as a critical area by the county soil and water districts of Jackson and Union counties and by the respective Agricultural Stabilization and Conservation Service (ASCS) county committees would help facilitate this process. The Jackson County Soil and Water Conservation District has given the Cedar Lake Watershed a high priority designation for water quality protection.

The suggested guidelines for the soil and water conservation districts is a proper beginning for controlling soil erosion and the resultant entering of toxic substances into Cedar Lake from old orchard lands.

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Appendix

UNIVERSAL SOIL LOSS EQUATION

The Universal Soil Loss Equation is a primary tool in estimating erosion of specific land areas. The equation takes into account the major factors determining the soil loss that will occur as a result of erosion. The basis equation can be expressed as:

$$A = R\ K\ L\ S\ C\ P$$

where:

A is the computed soil loss per year per unit area of land expressed in tons per acre.

R is the average annual rainfall erosion index or the average annual force of rainfall.

K is the soil erodibility factor. It is a measure of the rate at which a soil will erode expressed as tons per acre per year per unit of R for a 9 percent slope 72.6 feet long under continuous cultivated farrow. (Soil loss tolerance (T) is not found in the equation, but is important to the use of the equation in practical field application. It is the maximum soil loss in tons per acre per year which can be tolerated on a specific soil and still permit a high level of crop production to be sustained economically and indefinitely.)

L is the slope length factor. It is the ratio of soil loss from a specified slope length to that from a slope length of 72.6 feet long, which is the slope length for the K value in the equation. A slope length of 72.6 feet long has a factor value of 1.L as determined in the field.

S is the slope gradient factor. It is the ratio of soil loss from a specific slope gradient to that from a gradient of 9 percent, which is the slope gradient specified for the K value in the soil loss equation. A slope gradient of 9 percent has a factor value of 1.S as determined in the field. L and S are usually handled in combination. The soil loss ratio--SL, can be read directly from the slope-effect chart.

C is the cropping management factor. It is the ratio of soil loss from land cropped under specified conditions to the corresponding loss from the land in continuous fallow. Continuous fallow has a factor value of 1 in the equation.

P is the conservation practice factor. It is the ratio of soil loss from a specified conservation practice to that from up-and-down hill tillage operations. Up-and-down hill tillage has a factor value of 1 in the equation.

Source: Greater Egypt Regional Planning and Development Commission, November, 1978, Areawide Waste Treatment and Water Quality Management Plan for Southern Illinois, Appendix B-2, Pollution Sources: Agriculture.